



Interstellar Travel



■ Relative Distances

- Pluto is at 39 AU, Voyager is now at about 69 AU, The Kuiper Belt extends to 100 AU, The Oort Cloud may extend to 10,000 AU,
- Alpha Centauri is about 250,000 AU, 8 stars within 500,000 AU, 60 stars within 1,000,000 AU.

■ Performance Requirements

- To travel 4 light years within 40 years requires acceleration to an average speed of 0.1 c.
- To rendezvous one must decelerate from this speed.
- A 40 year single stage Alpha Centauri rendezvous rocket type vehicle requires an $I_{sp} > 4$ Million sec with a mass fraction of 97%.

■ Concepts (all have serious problems)

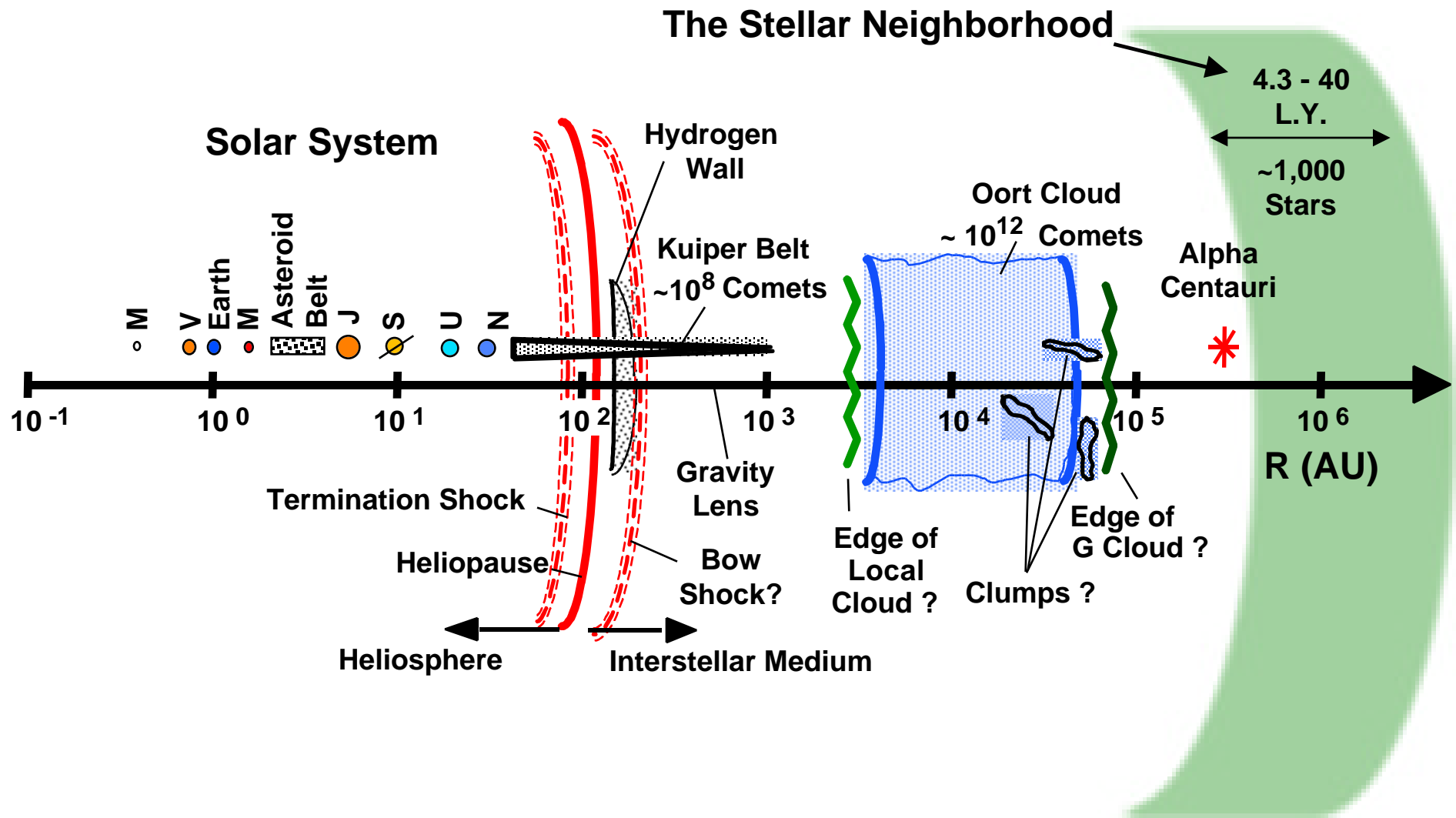
- Multi-stage fusion or antimatter rockets - staging fractions > 1000 .
- Bussard fusion ramjet - no concepts known for scooping and fusing interstellar hydrogen.
- Laser sail - feasible in principle, very large components are difficult to deploy and control.

■ Plans

- Initial focus on interstellar precursor missions - beyond Pluto.
- Use solar sail or nuclear electric.
- Interstellar Precursor Missions being studied by JPL and MSFC.



Nearby Interstellar Targets of Interest



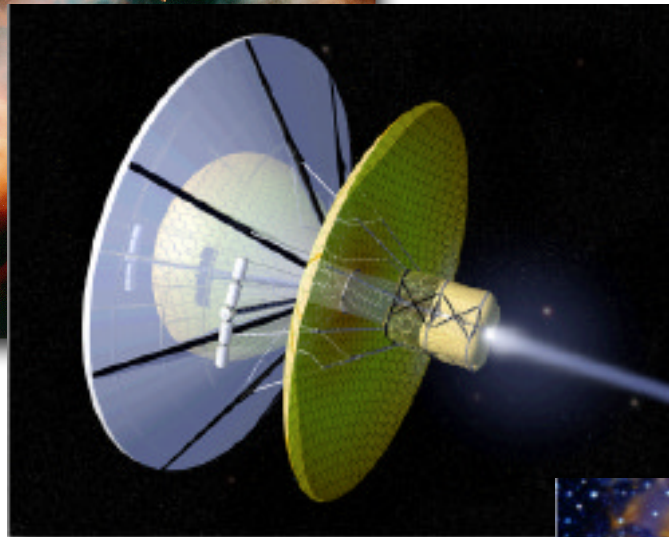
(Mewaldt, 1998)



■ Matter-Antimatter

(Highest Energy Density Propellant)

- Production, handling and storage
- Converting energy to propulsion



Fusion Ramjet

(Refueling on the Road)

- H-H fusion
- Large area magnetic scoops
- "Drag-free" fusion

■ Beamed Energy

(Propellantless Propulsion)

- Very high power lasers with large apertures
- Precision pointing
- Large, low density sails

